PB88-179940

Health Effects Assessment for 1,2-Dichloropropane

(U.S.) Environmental Protection Agency
Cincinnati, OH

Jun 87

U.S. Department of Commerce
National Technical Information Service

PB88-179940

EPA/600/8-88/029
June, 1987

HEALTH EFFECTS ASSESSMENT FOR 1,2-DICHLOROPROPANE

ENVIRONMENTAL CRITERIA AND ASSESSMENT OFFICE
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U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL
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SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)		
1. REPORT NO. EPA/600/8-88/029	2.	3. RECIPIENT'S ACCESSION NO. PB88 179940/AS
4. TITLE AND SUBTITLE Health Effects Assessment for 1,2-Dichloropropane		5. REPORT DATE June 1987
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Environmental Criteria and Assessment Office Office of Research and Development U.S. Environmental Protection Agency Cincinnati, OH 45268		13. TYPE OF REPORT AND PERIOD COVERED
		14. SPONSORING AGENCY CODE EPA/600/22
15. SUPPLEMENTARY NOTES		

16. ABSTRACT

This report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with specific chemicals or compounds. The Office of Emergency and Remedial Response (Superfund) uses these documents in preparing cost-benefit analyses under Executive Order 12991 for decision-making under CERCLA. All estimates of acceptable intakes and carcinogenic potency presented in this document should be considered as preliminary and reflect limited resources allocated to this project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, two categories of values have been estimated for systemic toxicants (toxicants for which cancer is not the endpoint of concern). The first, RfD_S or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs during a limited time interval. The RfD is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan. For compounds for which there is sufficient evidence of carcinogenicity, q_1^*s have been computed, if appropriate, based on oral and inhalation data if available.

17. KEY WORDS AND DOCUMENT ANALYSIS		
a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
18. DISTRIBUTION STATEMENT Public	19. SECURITY CLASS (This Report) Unclassified	21. NO. OF PAGES 31
	20. SECURITY CLASS (This page) Unclassified	22. PRICE PC A03/MF A01

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

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PREFACE

This report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with 1,2-dichloropropane. All estimates of acceptable intakes and carcinogenic potency presented in this document should be considered preliminary and reflect limited resources allocated to this project. Pertinent toxicologic and environmental data were located through on-line literature searches of the Chemical Abstracts, TOXLINE, CANCERLINE and the CHEMFATE/DATALOG data bases. The basic literature searched supporting this document is current up to May, 1986. Secondary sources of information have also been relied upon in the preparation of this report and represent large-scale health assessment efforts that entail extensive peer and Agency review. The following Office of Health and Environmental Assessment (OHEA) sources have been extensively utilized:

U.S. EPA. 1980a. Ambient Water Quality Criteria Document for Dichloropropanes and Dichloropropenes. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Water Regulations and Standards, Washington, DC. EPA 440/5-80-043. NTIS PB81-117541.

U.S. EPA. 1983a. Reportable Quantity Document for 1,2-Dichloropropane. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Emergency and Remedial Response, Washington, DC.

U.S. EPA. 1983b. Reportable Quantity Document for Dichloropropane. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Emergency and Remedial Response, Washington, DC.

U.S. EPA. 1984. Drinking Water Criteria Document for 1,2-Dichloropropane. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC. NTIS PB86-117850/AS.

U.S. EPA. 1985. Health and Environment Effects Profile for Dichloropropanes. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response, Washington, DC.

The intent in these assessments is to suggest acceptable exposure levels for noncarcinogens and risk cancer potency estimates for carcinogens whenever sufficient data were available. Values were not derived or larger uncertainty factors were employed when the variable data were limited in scope tending to generate conservative (i.e., protective) estimates. Nevertheless, the interim values presented reflect the relative degree of hazard or risk associated with exposure to the chemical(s) addressed.

Whenever possible, two categories of values have been estimated for systemic toxicants (toxicants for which cancer is not the endpoint of concern). The first, RfD_S (formerly AIS) or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs during a limited time interval (i.e., for an interval that does not constitute a significant portion of the lifespan). This type of exposure estimate has not been extensively used, or rigorously defined, as previous risk assessment efforts have been primarily directed towards exposures from toxicants in ambient air or water where lifetime exposure is assumed. Animal data used for RfD_S estimates generally include exposures with durations of 30-90 days. Subchronic human data are rarely available. Reported exposures are usually from chronic occupational exposure situations or from reports of acute accidental exposure. These values are developed for both inhalation (RfD_{SI}) and oral (RfD_{SO}) exposures.

The RfD (formerly AIC) is similar in concept and addresses chronic exposure. It is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan [see U.S. EPA (1980b) for a discussion of this concept]. The RfD is route-specific and estimates acceptable exposure for either oral (RfD_O) or inhalation (RfD_I) with the implicit assumption that exposure by other routes is insignificant.

Composite scores (CSs) for noncarcinogens have also been calculated where data permitted. These values are used for identifying reportable quantities and the methodology for their development is explained in U.S. EPA (1983).

For compounds for which there is sufficient evidence of carcinogenicity RfD_S and RfD values are not derived. For a discussion of risk assessment methodology for carcinogens refer to U.S. EPA (1980b). Since cancer is a process that is not characterized by a threshold, <u>any</u> exposure contributes an increment of risk. For carcinogens, q_1^*s have been computed, if appropriate, based on oral and inhalation data if available.

ABSTRACT

In order to place the risk assessment evaluation in proper context, refer to the preface of this document. The preface outlines limitations applicable to all documents of this series as well as the appropriate interpretation and use of the quantitative estimates presented.

1,2-Dichloropane produced dose-related increases in hepatic adenomas/carcinomas in mice of both sexes given oral doses of 125 or 250 mg/kg, 5 days/week for 2 years (NTP, 1986). It was not clear if increases in mammary adenocarcinomas in female rats or thyroid follicular cell tumors in mice were also treatment-related. NTP (1986) noted the high background incidence of liver tumors in male mice, but considered the increased hepatic tumor response biologically significant. Adequate data for assessment of the carcinogenic potency of 1,2-dichloropropane by inhalation exposure were not found in the available literature.

U.S. EPA (1984, 1985) calculated a human q_1^* of 6.33×10^{-2} $(mg/kg/day)^{-1}$, based upon the hepatic tumor incidence observed in male mice. Several positive mutagenicity assays, particularly concerning chromosomal aberrations, substantiate the weak carcinogenic potency of 1,2-dichloropropane. The NTP draft report of 1983 was a preliminary draft and reanalysis of carcinogenic risk values are now available (NTP, 1986). The re-evaluated q_1^* of 6.75×10^{-2} $(mg/kg/day)^{-1}$ based on the hepatic tumor incidence observed in male mice is now considered the most appropriate cancer risk assessment superceding these earlier assessments.

ACKNOWLEDGEMENTS

The initial draft of this report was prepared by Syracuse Research Corporation under Contract No. 68-03-3112 for EPA's Environmental Criteria and Assessment Office, Cincinnati, OH. Dr. Christopher DeRosa and Karen Blackburn were the Technical Project Monitors and John Helms (Office of Toxic Substances) was the Project Officer. The final documents in this series were prepared for the Office of Emergency and Remedial Response, Washington, DC.

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Carcinogen Assessment Group
Office of Air Quality Planning and Standards
Office of Solid Waste
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LIST OF ABBREVIATIONS

AADI	Adjusted acceptable daily intake
CAS	Chemical Abstract Service
CNS	Central nervous system
CS	Composite score
DNA	Deoxyribonucleic acid
HA	Health advisory
LOEL	Lowest-observed-effect level
MED	Minimum effective dose
NOEL	No-observed-effect level
OCT	Ornithine carbamyl transferase
PEL	Permissible exposure level
ppm	Parts per million
ppt	Parts per trillion
RfD	Reference dose
RfD_I	Inhalation reference dose
RfD_O	Oral reference dose
RfD_S	Subchronic reference dose
RfD_{SI}	Subchronic inhalation reference dose
RfD_{SO}	Subchronic oral reference dose
RNA	Ribonucleic acid
RV_d	Dose-rating value
RV_e	Effect-rating value
SCE	Sister chromatid exchange
SGOT	Serum glutamic oxaloacetic transaminase
SGPT	Serum glutamic pyruvic transaminase

LIST OF ABBREVIATIONS (cont.)

STEL	Short-term exposed level
TLV	Threshold limit value
TWA	Time-weighted average

1. ENVIRONMENTAL CHEMISTRY AND FATE

Selected chemical and physical properties and environmental fate of 1,2-dichloropropane are presented in Table 1-1.

In the atmosphere, 1,2-dichloropropane should occur mostly in the vapor phase and appears to be susceptible to oxidation by HO radical (U.S. EPA, 1985). The atmospheric half-life listed in Table 1-1 was calculated using a reaction rate constant of $\leq 4.4 \times 10^{-13}$ cm³/molecule-sec at 23°C (Atkinson, 1985) and a HO radical concentration of 8.0×10^{5} molecules/cm³ (U.S. EPA, 1986a). In water and soil, volatilization appears to be the major mechanism in determining the fate of 1,2-dichloropropane. The aquatic half-life listed in Table 1-1 was calculated using the U.S. EPA EXAMS computer simulation and a measured Henry's Law constant of 0.00231 atm-m³/mol. Bioaccumulation in aquatic organisms and adsorption to sediments by 1,2-dichloropropane should not be significant (U.S. EPA, 1985).

The soil half-life listed in Table 1-1 is based on a study examining the volatility of ^{14}C-2-labeled 1,2-dichloropropane from a sandy loam soil under simulated conditions. Ten days after application, <1% of the original radiolabel remained in the soil, which corresponds to a half-life of <2 days. Low adsorption to soil and monitoring data indicate that 1,2-dichloropropane is highly mobile in soil and may leach into groundwater (U.S. EPA, 1985).

TABLE 1-1

Chemical and Physical Properties and Environmental Fate
of 1,2-Dichloropropane

Property	Value	Reference
CAS number:	78-87-5	
Chemical name:	halogenated aliphatic hydrocarbon	
Molecular weight:	112.99	
Vapor pressure:	42 mm Hg at 20°C	U.S. EPA, 1985
	50 mm Hg at 25°C	U.S. EPA, 1985
Water solubility:	2700 mg/ℓ at 20°C	U.S. EPA, 1985
Log octanol/water partition coefficient:	2.02-2.28 (estimated)	U.S. EPA, 1985
Bioconcentration factor:	~10, carp (Cyprinus carpio)	Kawasaki, 1980
Soil adsorption coefficient:	27-51	U.S. EPA, 1985
Half-lives in		
Air:	~23 days	Atkinson, 1985
Water:	1.6 days (river),estimated	U.S. EPA, 1985
	1.7 days (pond), estimated	U.S. EPA, 1985
	10 days (eutrophic lake), estimated	U.S. EPA, 1985
	11 days (oligotrophic lake), estimated	U.S. EPA, 1985
Soil:	<2 days	U.S. EPA, 1985

2. ABSORPTION FACTORS IN HUMANS AND EXPERIMENTAL ANIMALS

2.1. ORAL

Data regarding the absorption of 1,2-dichloropropane after oral administration in humans could not be located in the available literature

Male rats given a single oral 0.88 mg dose of 1,2-dichloro(1-^{14}C)-propane (8.5 μCi) excreted 5.0% of the administered radioactivity in the feces after 24 hours and 6.8% after 96 hours (Hutson et al., 1971). Females excreted 3.8% of the administered radioactivity in the feces after 24 hours and 4.9% after 96 hours. The investigators observed that 80-90% of the administered radioactivity was eliminated by all routes within 24 hours of dosing. These results indicate that 1,2-dichloropropane is extensively and rapidly absorbed after oral administration.

2.2. INHALATION

Pertinent data regarding the absorption of 1,2-dichloropropane after inhalation exposure in either humans or experimental animals could not be located in the available literature.

3. TOXICITY IN HUMANS AND EXPERIMENTAL ANIMALS

3.1. SUBCHRONIC

3.1.1. Oral. NTP (1986) conducted a 13-week gavage study using groups of 10 male and 10 female F344/N rats and 10 male and 10 female B6C3F1 mice. 1,2-Dichloropropane (99.4% pure) in corn oil was given 5 days/week at 0, 60, 125, 250, 500 or 1000 mg/kg to rats and at 0, 30, 60, 125, 250 or 500 mg/kg to mice. All treated male and female rats at 1000 mg/kg/day and 5/10 males treated with 500 mg/kg/day died before the end of the study. Hepatic changes, including centrilobular congestion, necrosis and fatty changes, predominated in the 1000 mg/kg/day rats. No treatment-related effects were observed in rats given ≤250 mg/kg/day. In mice given ≤500 mg/kg/day, there were no effects on histopathology and isolated instances of mortality were not treatment-related.

3.1.2. Inhalation. Sidorenko et al. (1979) continuously exposed male rats to 1.5 or 9 mg/m³ 1,2-dichloropropane for 86 days. There were no apparent effects on body weights or limited hematological parameters. Effects on the CNS, evaluated by a change in "total threshold indicator" (not otherwise defined), were observed only at termination at 9 mg/m³. Changes (probably elevation) in blood cholinesterase activity were noted at 9 mg/m³ after 25 days of exposure. Other changes of questionable biological significance reported for rats at 9 mg/m³ included ultrastructural changes in the lungs, slightly decreased RNA content and increased DNA content (evidence of increased ploidy) in the liver, and slightly increased liver enzyme activities (not specified).

Heppel et al. (1948) found few changes in rats, guinea pigs or dogs exposed 7 hours/day, 5 days/week for ~28 weeks to 400 ppm (1840 mg/m³) 1,2-dichloropropane; C57 mice exposed under the same conditions all died within 12 sessions and nearly all exposed C3H mice died within 37 sessions.

Histological examination of the mice revealed congestion, fatty degeneration of the livers and kidneys, and centrilobular necrosis.

In a 13-week inhalation study using rats, mice and rabbits, groups of 10 rats/sex and 10 mice/sex were exposed to 0, 15, 50 or 100 ppm (0, 69, 230 or 691 mg/m^3) 1,2-dichloropropane 6 hours/day, 5 days/week (Dow Chemical Co., 1985). Groups of seven rabbits/sex were exposed to 0, 150, 500 or 1000 ppm (0, 691, 2300 or 4600 mg/m^3) 1,2-dichloropropane 6 hours/day, 5 days/week. Histological examination of nasal tissue revealed a slight to very slight degeneration of olfactory tissues in rats exposed to 50 and 150 ppm. This effect was also observed in some (number not specified) male rabbits exposed at 1000 ppm, but was not observed in mice. Rats exposed to 50 and 150 ppm had slight respiratory epithelial hyperplasia also, and hyperplasia was observed in a few (number not specified) rats exposed to 15 ppm 1,2-dichloropropane.

Anemia (determined by blood test) was considered a dose-related effect for male rabbits at all dose levels, and for female rabbits at the 500 and 1000 ppm dose levels. Upon examination of blood smears and histopathology of bone marrow, the anemia appeared to be regenerative. Anemia was not observed in rats or mice. Further details of this study were not provided in the preliminary report.

3.2. CHRONIC

3.2.1. Oral. NTP (1986) orally administered 0, 125 or 250 mg/kg 1,2-dichloropropane, 5 days/week, to groups of 50 female rats and 50 male and 50 female mice, and 0, 62 or 125 mg/kg, 5 days/week, to groups of 50 male rats for 103 weeks. Male and female rats had dose-related decreases in body weight gain; a depression of terminal body weight >10% was noted in high-dose males and females. The mortality rate among high-dose female rats was

greatly accelerated, but survival in low-dose females and male rats was unaffected. Treatment-related nonneoplastic changes in rats included mammary gland hyperplasia (low-dose females), foci of hepatic clear cell changes and hepatocellular necrosis (high-dose females). Treatment with either dose significantly decreased survival in female mice. Hepatocytomegaly and hepatic necrosis occurred in a dose-related manner in males. Forestomach acanthosis occurred at a slightly increased incidence in high-dose males and both treated groups of females and suppurative inflammation (particularly of the reproductive organs) occurred more frequently in treated females that died before the end of the study, compared with controls

3.2.2. Inhalation. Pertinent data regarding the toxicity of 1,2-dichloropropane after chronic inhalation exposure could not be located in the available literature.

3.3. TERATOGENICITY AND OTHER REPRODUCTIVE EFFECTS

Pertinent data regarding the teratogenicity of oral or inhalation exposure to 1,2-dichloropropane could not be located in the available literature. Shaipak (1976) observed that exposure to 9 mg/m^3, for an unspecified duration, impaired spermatogenesis in rats.

3.4. TOXICANT INTERACTIONS

Drew et al. (1978) found that simultaneous inhalation exposure to 1,2-dichloropropane and trichloropropane synergistically increased SGPT levels and had additive effects on SGOT and OCT levels, 24 hours after exposure; however, effects of this combination on each enzyme were antagonistic at 48 hours. U.S. EPA (1984) concluded that, overall, the compounds did not act in a synergistic manner.

4. CARCINOGENICITY

4.1. HUMAN DATA

Pertinent data regarding oral or inhalation exposure in humans and resultant carcinogenicity could not be located in the available literature.

4.2. BIOASSAYS

4.2.1. Oral. The only available carcinogenesis bioassay of 1,2-dichloropropane is provided as a final report by the NTP (1986) (see Section 3.2.1.). Male rats treated by gavage with 62 or 125 mg/kg, 5 days/week for 103 weeks had significantly increased incidence of any tumor type. Treated female rats had significantly increased incidences of mammary adenocarcinomas (0 mg/kg, 1/50; 125 mg/kg, 2/50; 250 mg/kg, 5/50); although not significantly different at p=0.05 when compared with the incidence in controls by the Fischer exact test, the incidences were statistically significant for dose-related trends by the life table and incidental tumor tests. NTP (1986) considered the mammary tumor response in female rats to be equivocal evidence for its carcinogenic potential.

Incidence data for treatment-related increases in hepatic adenoma and carcinomas combined in mice are shown in Table 4-1. Significant dose-related trends for these tumor types were observed in both sexes, and the tumor response was significantly elevated at 250 mg/kg in both sexes. Significant dose-related trends for liver adenomas in males and females were also found (data not shown). NTP (1986) observed nonsignificant trends in the incidences of liver carcinomas in both males (0 mg/kg, 11/50; 125 mg/kg, 17/49; 250 mg/kg, 16/50) and females (0 mg/kg, 1/50; 125 mg/kg, 3/50; 250 mg/kg, 4/50). The investigators noted the high historical background rate of hepatic tumors in male B6C3F1 mice and the genetic heterogeneity of the parent (C3H) strain, but concluded that the findings were of biological significance.

TABLE 4-1

Hepatic Adenoma/Carcinoma Incidence in B6C3F1 Mice
Orally Administered 1,2-Dichloropropane (>99.4% pure)
in Corn Oil for 103 Weeks[a]

Sex	Dose[b] (mg/kg)	Tumor Incidence
M	0	18/50
	125	26/49
	250	33/50
F	0	2/50
	125	8/50
	250	9/50

[a]Source: NTP, 1986

[b]Administered by gavage 5 times/week

Thyroid follicular cell tumors (adenomas and carcinomas) occurred in 5/46 high-dose female mice; control incidences for these tumor types were 1/48. NTP (1986) was uncertain that these tumors were treatment-related, but noted that incidence in female mice may have been underestimated because of the early mortality that occurred in this group.

4.2.2. Inhalation. Pertinent data regarding tumor development after chronic inhalation exposure to 1,2-dichloropropane could not be located in the available literature. Heppel et al. (1948) reported that thirty-seven 4- to 7-hour exposure sessions to 1,2-dichloropropane induced multiple hepatomas in mice. In this experiment, 80 C3H mice were exposed for 4-7 hours daily, 5 days/week to 400 ppm (1840 mg/m^3). Survival was poor and the cause of death apparently was related to severe liver necrosis. Only three mice survived the exposures and a subsequent 7-month observation period, and they had multiple hepatomas similar to those induced by known hepatocarcinogens. Apparently, controls were not included in this experiment.

4.3. OTHER RELEVANT DATA

Several researchers (NTP, 1986; Haworth et al., 1983; Principe et al., 1981) found that 1,2-dichloropropane was marginally-to-strongly mutagenic in Salmonella typhimurium strains TA100 and TA1535. The extent of genotoxicity was consistently diminished by addition of an S-9 microsomal fraction. 1,2-Dichloropropane has not been shown to have any direct alkylating activity, while the metabolite 1,2-epoxypropane has been shown to be an alkylating agent (Jones and Gibson, 1980). The role of metabolite activation in 1,2-dichloropropane toxicity is not clear. Principe et al. (1981) also found that 1,2-dichloropropane induced forward mutations in Aspergillus nidulans, but it was ineffective in inducing somatic segregation in the same

species (Crebelli et al., 1984). 1,2-Dichloropropane was associated with SCE and chromosomal aberrations in Chinese hamster ovary cells (NTP, 1986), and Dragusanu and Goldstein (1975) demonstrated chromosomal aberrations in bone marrow cells from 1,2-dichloropropane-treated rats. Woodruff et al. (1985) observed that 1,2-dichloropropane did not cause sex-linked recessive lethality in Drosophila melanogaster.

4.4. WEIGHT OF EVIDENCE

The evidence for the carcinogenicity of 1,2-dichloropropane is both direct and indirect. From animal bioassays there is significantly increased liver tumor incidence (adenomas and carcinomas combined) in male and female B6C3F1 mice. In male F344 rats there is no significant response while in female rats there is an elevated trend response in mammary gland adenocarcinomas with a negative trend in incidence of fibroadenomas. Thyroid follicular cell adenomas and carcinomas were significantly increased in high-dose female mice but not in low-dose females. Taken together the liver tumor response provides limited to borderline sufficient evidence of carcinogenicity with the mammary and thyroid responses being supportive of possible carcinogenic potential. Indirectly, the evidence of mutagenic activity; the probability that metabolites of 1,2-dichloropropane are formed, one being 1,2-epoxypropane which is an alkylating agent, and the structural similarity of 1,2-dichloropropane to other chemicals that are carcinogenic in rats and mice (DBCP, 1,2-dichloroethane, 1,2-dibromoethane) provides a basis to firmly upgrade the weight of evidence to EPA Group B2. EPA Class B2 compounds have inadequate human evidence but sufficient evidence from animal studies, and IARC Group 2B includes chemicals in which the evidence for carcinogenicity to humans ranges from suggestive to almost sufficient. These classifications reflect the evaluation of a previous U.S. EPA (1985) analysis.

5. REGULATORY STANDARDS AND CRITERIA

Because of the limitations of the available data base, U.S. EPA (1980a) did not derive a satisfactory ambient water quality criterion for 1,2-dichloropropane, using conventional methodology. The Agency cited a 30-day study by Kurysheva and Ekshtat (1975), in which oral doses of 14.4 mg/kg/day to rats produced changes in serum enzyme levels, for derivation of provisional water criteria. Application of an uncertainty factor of 1000 to this LOEL and use of standard assumptions (70 kg human body weight, 0.0065 kg/day fish consumption, and a bioconcentration factor of 4.11) resulted in a water level of 483 µg/ℓ.

ACGIH (1985) adopted a TLV-TWA of 75 ppm (~350 mg/m³) and a 15-minute STEL of 110 ppm (~510 mg/m³) for 1,2-dichloropropane. ACGIH (1986) stated that the TLV-TWA was based upon the Heppel et al. (1946, 1948) studies, but recommended that it be reconsidered because the TLVs for other hepatotoxic halogenated compounds have recently been reduced.

U.S. EPA (1984) considered toxicological data insufficient for calculation of a 1-day or 10-day child or adult HA, or a lifetime AADI. Alternatively, the Agency suggested a 7-day level of 0.3 mg/ℓ, based upon the limited toxicity data of Ekshtat et al. (1975), until more adequate data were available.

6. RISK ASSESSMENT

6.1. REFERENCE DOSE (RfD) AND SUBCHRONIC REFERENCE DOSE (RfD_S)

Because oral 1,2-dichloropropane induced increases in liver tumor incidence in mice (NTP, 1986), it would be inappropriate to derive RfD or RfD_S values for either the oral or the inhalation route.

6.2. CARCINOGENIC POTENCY (q_1^*)

6.2.1. Oral. U.S. EPA (1985) derived q_1^*s for increased lifetime risk in humans from hepatic adenoma/carcinoma data from both male and female mice based on a 1983 draft of the aforementioned 1986 NTP study. The data used in the derivation of these q_1^*s have now been revised in the final NTP draft and these data are shown in Tables 6-1 and 6-2. The linearized multistage model adopted by the U.S. EPA (1980b) was used to estimate the excess risk to humans associated with oral exposure to 1,2-dichloropropane. The human q_1^*s derived are 6.75×10^{-2} $(mg/kg/day)^{-1}$ and 2.19×10^{-2} $(mg/kg/day)^{-1}$ from data on the males and females, respectively. Because the human q_1^* derived from the male mouse data was higher, it was recommended for estimation of increased lifetime cancer risk.

There was no additional recent information that would affect risk assessment. The derived q_1^* should therefore be provisionally accepted until the final National Toxicology Program report is available.

6.2.2. Inhalation. Data regarding the carcinogenic potency of 1,2-dichloropropane following inhalation exposure were insufficient for estimation of carcinogenic potency.

TABLE 6-1

Derivation of q_1^* for 1,2-Dichloropropane

Reference: NTP, 1986

Species/strain/sex: mouse, B6C3F1, male

Route/vehicle: gavage, corn oil

Length of exposure (le) = 103 weeks

Length of experiment (Le) = 105-107 weeks

Lifespan of animal (L) = 105-107 weeks

Body weight = 0.04 kg (measured)

Tumor site and type: liver, adenoma or carcinoma

Experimental Doses or Exposures (mg/kg/day, 5 days/week)	Transformed Dose (mg/kg/day)	Incidence No. Responding/No. Tested
0	0	18/50
125	86.8	26/50
250	173.5	33/50

Unadjusted q_1^* from study = 5.60428×10^{-3} $(mg/kg/day)^{-1}$

Human q_1^* = 6.753556×10^{-2} $(mg/kg/day)^{-1}$

TABLE 6-2

Derivation of q_1^* for 1,2-Dichloropropane

Reference: NTP, 1986

Species/strain/sex: mouse, B6C3F1, female

Route/vehicle: gavage, corn oil

Length of exposure (le) = 103 weeks

Length of experiment (Le) = 105-107 weeks

Lifespan of animal (L) = 105-107 weeks

Body weight = 0.038 kg (measured)

Tumor site and type: liver, adenoma or carcinoma

Experimental Doses or Exposures (mg/kg/day, 5 days/week)	Transformed Dose (mg/kg/day)	Incidence No. Responding/No. Tested
0	0	2/50
125	86.8	8/50
250	173.5	9/50

Unadjusted q_1^* from study = 1.78892×10^{-3} $(mg/kg/day)^{-1}$

Human q_1^* = 2.19296×10^{-2} $(mg/kg/day)^{-1}$

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APPENDIX

Summary Table for 1,2-Dichloropropane*

Route	Species	Experimental Dose (mg/kg/day)	Effect	q_1^* or Unit Risk
Oral	mouse	0, 125, 250, 5 days/week for 103 weeks	dose-related increases in hepatic adenomas/ carcinomas	6.75×10^{-2} $(mg/kg/day)^{-1}$

*Source: NTP, 1986